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IS THERE A STORM ALONG THE AIR ROUTE?

By

N. Makarov



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BY: N. Makarov

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PREPARED BY:

TRANSLATION SERVICES BRANCH
FOREIGN TECHNOLOGY DIVISION
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Is there a Storm Along the Air Route ?

by

N. Makarov

Cloudiness reigns over the air route... what kind of cloudiness? Its boundaries ? Region of propagation ? Are there any thunderstorm nidi ?

These questions, it is perfectly understood, do agitate the dispatcher handling air traffic. The fact is, under difficult meteorological conditions he must quite often solve independently responsible problems on the vectoring of aircraft, because the crew - ship commander and navigator cannot see and know the air situation along the route. And the dispatcher- their first assistant, counselor and - mainly - supervisor. No wonder then that the saying goes, that workers of the traffic service should not remain passive onlookers, but actively direct the flights.

SEE PAGE 1a

SEE PAGE 1b

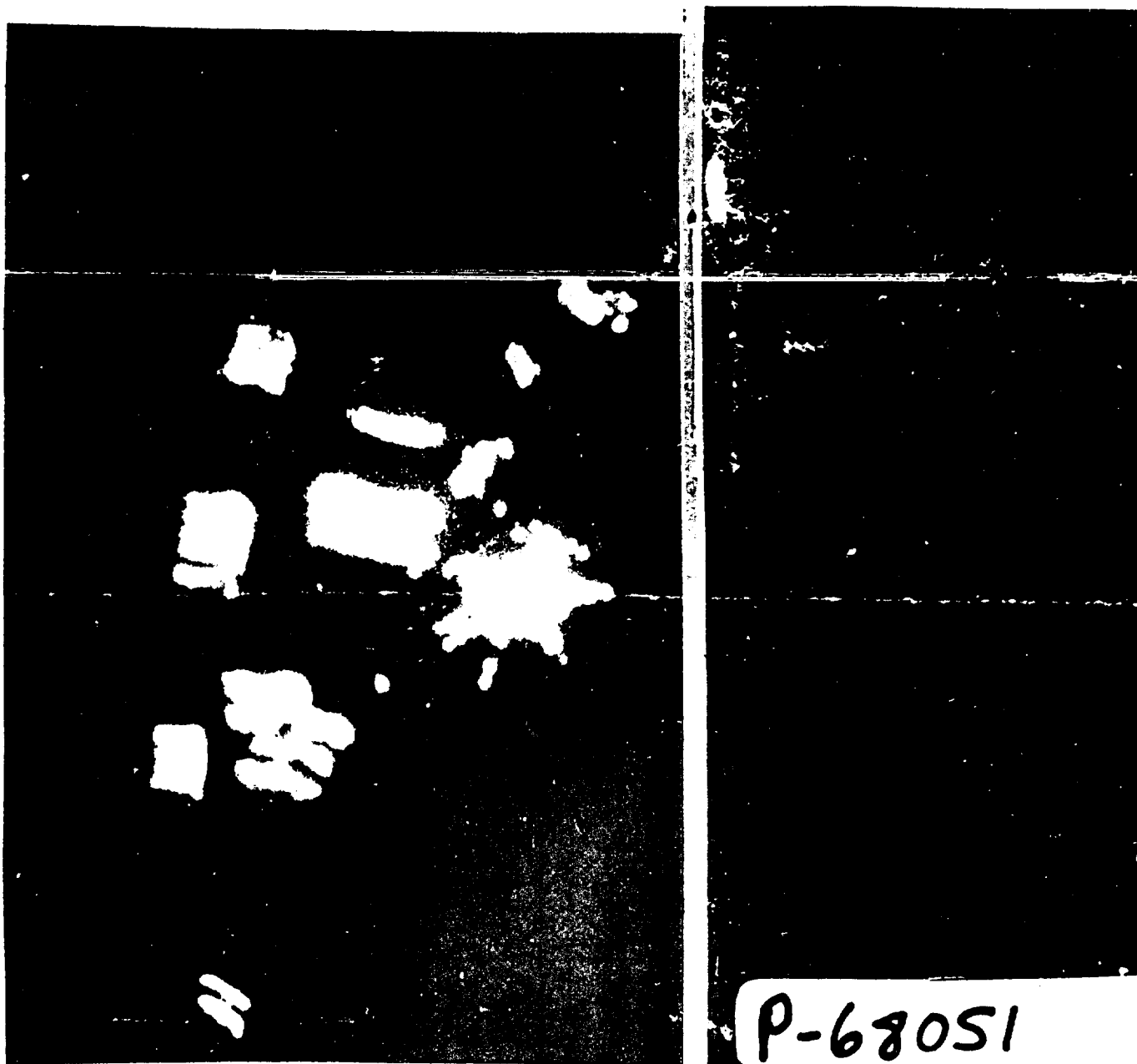
Illustr.1. stratus-cumulus and stratus- Illustr.2. highly stratus cloudiness.No
nimbus clouds,drizzle,no storm storm.

The Eyes of the Dispatcher

To direct aircraft traffic one must know how to analyze the meteorological con-



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dition. For the dispatcher this is a problem of problems. And such an analysis can be made only during complex utilization of all radiotechnical media. We emphasize complex utilization.

True, it cannot be assumed that this is perfectly sufficient to analyze the meteorological situation. It is also necessary to take under consideration the reports by crews, announcements of neighboring locator and radio navigation points, including also auxiliary points, consultations of synoptics. Nonetheless complex utilization of radio technical equipment (media), which are now to the dispatcher's disposal, is an important prerequisite for successfully solving problems on the vectoring of aircraft at the time of difficult synoptic situation.

The basic means of detecting dangerous meteorological phenomena is omnidirectional radar. On its indicator showing various types of cloudinesses, precipitations, thunderstorm nidi differ by their peculiar image and configurations. You must well remember same and you will be able to determine the nature of the cloudiness and other meteorophenomena.

Shower precipitations and snow fall, as can be judged by the illustration, are depicted on the indicator in form of a continuous pale glow of light with weakly expressed edge of clouds. But a highly stratus cloud emits a bright light, and this only over individual sections. Its configuration has sharply defined irregular edges with more intensive illumination in the center (see illustration). It is also possible to remember: glows of highly stratus cloudiness are much brighter, than from shower precipitations.

It is of particular importance to know how to determine thunderstorm cloudiness and thunderstorm nidi. That cloudiness has thunderstorm nidi is evident by peculiar open and closed rings of irregular form. Thunderstorm cloudiness, in addition, depending upon the duration of movement of air masses, may be extended in any one side. In the illustration, published in this edition of the journal, is photographed an indicator with an image of two thunderstorm nidi. One is situated at a distance

of 58 km along the azimuth of 142°; the second one - at a distance of 110 km along the 180° azimuth. Cloudiness travels from south-west toward north-east. We also publish an illustration of a radar image of a frontal thunderstorm situated at about 330° azimuth.

SEE PAGE 3a

SEE PAGE 3b

Illustr.3. cumulus cloud in region of radar station. Two thunderstorm nidi are visible.

Illustr.4. frontal thunderstorm

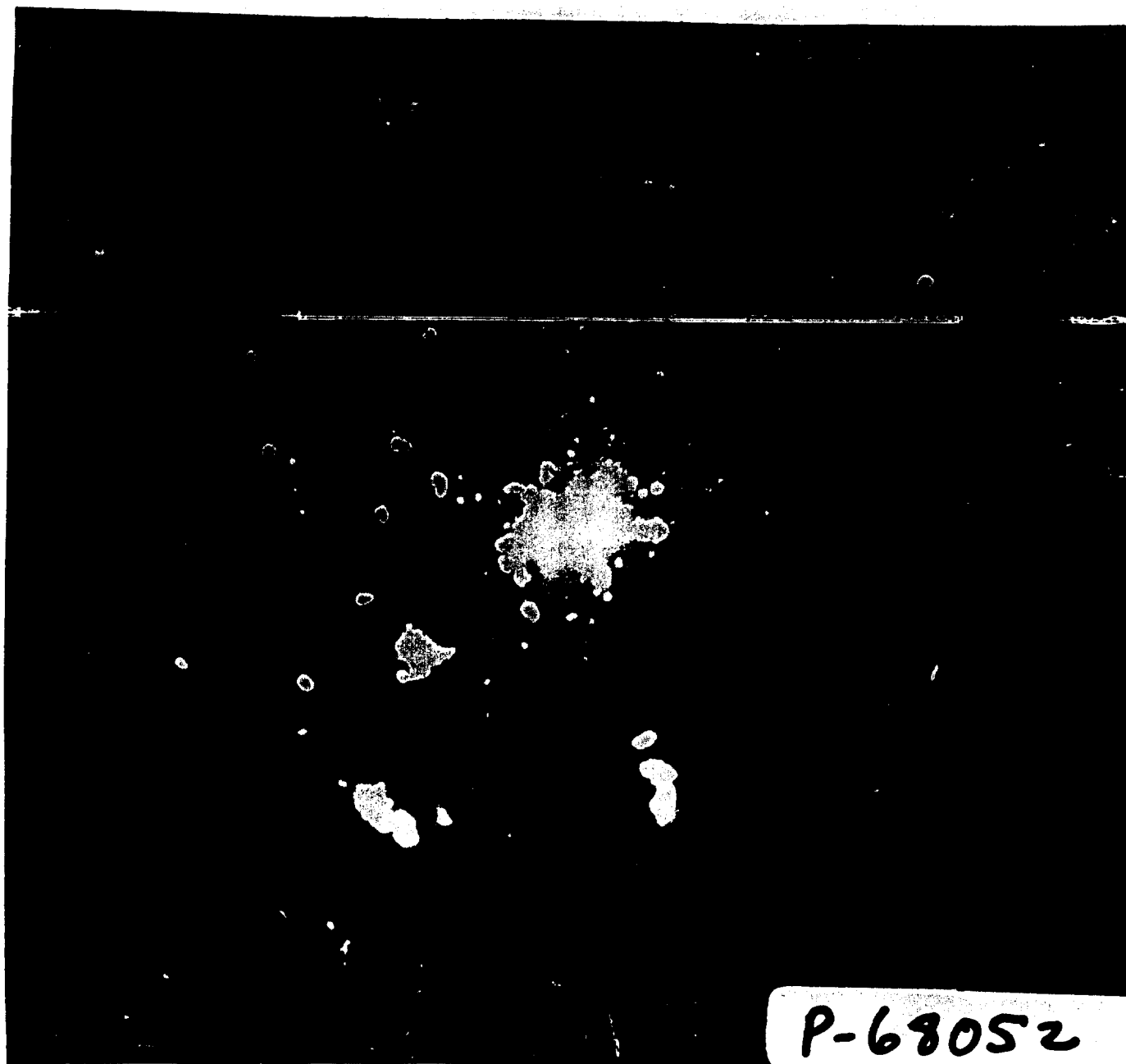
illustration 4, frontal thunderstorm

On both illustrations are well visible the rings of thunderstorm nidi. Senior dispatcher of one of the radar station of the Aeroflot R. Musailov, supporting himself on his observations, maintains, that when clearances are formed in a closed ring - thunderstorm abates and, vice versa, when the ring closes - discharges do again appear. ^{Whether} there is truly such a rule governing the development of thunderstorm activity -

is so far difficult to say. In any event, this statement should be verified, and this can be done by traffic service personnel.

The dispatcher using omnidirectional radar to determine dangerous meteorological phenomena should take its possibilities into consideration. And so for example, the indicator sometimes does not show the true boundaries of cloudiness. Actually the cloudiness may stretch over larger distances, which is determinable by the image on the indicator. Furthermore, we know of a case, when from board the aircraft was visible a powerful stratus cloud, and the dispatcher of the auxiliary radar-dispatcher point could not detect same. It was not seen on the indicator.

What then should be done in such cases? First of all it is necessary to take into consideration crew reports. If they do report that an intensively stratus cloud





is seen or, the more so- storm discharges, the dispatcher, naturally, should keep these announcements in mind. Simultaneously it is necessary, if there is a possibility, to inquire from neighboring radar stations and airfields.

We have already mentioned, that radio technical means must be used in complex. What does it mean ?

We will assume that the radar indicator indicates cloudiness. In order to more accurately determine its nature it is necessary to employ ground radar interrogation and ultrashortwave direction finder.

The first one allows to determine thunderstorm phenomena in the region of its action. When there are thunderstorm discharges along the air route, the indicator of the interrogator shows flashes of pulsating nature. True, it is impossible to determine the azimuth and distance to the thunderstorm nidi by the interrogator indicator, but to determine whether or not there is a thunderstorm - is absolutely possible.

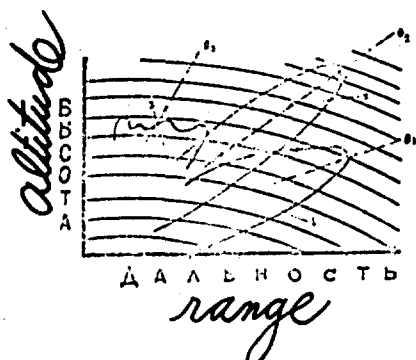
The readings of the interrogator are supplemented by the ultrashortwave direction finder. In cases, when thunderstorm discharge reign along the air route, the indicator of the direction finder shows discharges of bearings, whereby their direction coincides with the direction of the storm zone.

Storm indications along the route - a signal for the dispatcher. It is his duty to immediately determine by the direction obtained with the aid of a direction finder the point of its action. This can be done, as we have already spoken, by the image of the indicator of the omnidirectional radar.

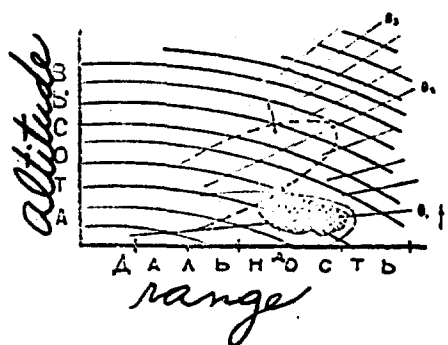
But for the dispatcher of air traffic service is important to know not only the place of action of the storm, but also where the flying aircraft is at this particular moment. Another time a storm cloud, rain or snow, producing on the indicator continuous lighted spots, and this makes the determination of aircraft position very difficult: its marker simply disappears. In such instances by alternate connection and disconnection of channels of the omnidirectional radar we establish separately

over which of these channels "passes" the echo-signal and signal of interference. The interference channels are shut off, and it becomes possible to detect the blip (marker) of the aircraft. If the cut off of interfering channels does not assure satisfactory visibility, it is necessary to cut in the differentiating circuit and instantaneous automatic amplification control (MARU).

In some instances of interferences, interfering with the identification of the aircraft, they are removed by changing the angle of inclination of the radar. This job, we will say plainly, is not a difficult one, it is only necessary to raise or lower the antenna, but dispatchers do quite frequently forget, that there is such a way of eliminating interferences.



Approximate radiation pattern of omni directional radar



Principle of determining altitude of clouds with the aid of radar.

With the aid of a scanning radar it is also possible to determine, true with great approximation the altitude of the cloudiness or the flight altitude of the aircraft. Such measurements are carried out by disconnection of upper channels and change in angle of antenna inclination. The measurement results are read from the radiation pattern. Such an approximate pattern for the locator (radar), having three channels, you can see on one of our drawings. At zero antenna inclination maximum radiation of each channel is situated under a definite angle to the horizon (in drawing - \odot_1 , \odot_2 and \odot_3) and are mutually connected. If the angle of antenna inclination is changed by a definite number of degrees, then by the very same corresponding number of degrees will be displaced the maxima inclinations of all three beams.

On the second drawing is shown the principle of determining the altitude of the cloudiness. As we see the upper channels are off. Antenna is lowered. The dispatcher changes the angle of its inclination up to the moment when the cloudiness image on the indicator disappears or decreases to minimum. We will assume, that this took place when raising the antenna to position Θ_2 . It is evident on the indicator that the closer edge of the cloudiness is situated at a certain distance (in fig. - D_1). Arranging on the diagram an image of the lobe of lower channel at an angle Θ_2 we find the upper edge of the clouds. Here, naturally, is the end of the cloudiness.

The accuracy obtained when determining the vertical boundaries of intense stratus clouds by this method, is perfectly satisfactory to analyze meteorological conditions along the air route. Dispatchers R. Musailov, A. Orlov, V. Shibayev, A. Kondratyev and others applying this method for a period of a number of years are attaining good results and offer great assist to crews of flying aircraft.

As to the determination of altitude of flying aircraft with the aid of a scanning radar, the accuracy obtainable by this method, is insufficient. But measurement results allow to determine the relative positions of aircraft in altitude.

Let us say, two aircraft are flying at short intervals. The dispatcher knows that one flies at 1500 m, and the other one at 2700 m. In order to determine with the aid of radar which one is at higher altitude it is necessary to cut off the upper channels and raise the antenna by 2-3 degrees. The marker of the aircraft travelling at lower altitude will disappear. The other aircraft which flies at higher altitude, will be watched as before on the indicator of the omnidirectional locator. The altitude of its flight will be defined by the radiation pattern.

In order to facilitate and simplify the operation with the diagram, it is advisable to prepare, from Flexiglass, a movable image of locator channel lobes and superimpose same over the diagram so that they should move within limits of antenna angle of inclination.

In conclusion we would like to emphasize especially, that the omnidirectional

radar does not show the actual boundaries of the cloudiness, since its image, as a rule, is smaller than in actuality. Consequently its vertical and horizontal boundaries can be determined accurately only with consideration of crew reports and announcements of neighboring radar stations. If along the way is observed a stratus or intense stratus cloudiness, it is necessary with special care to make certain that there are no thunderstorm phenomena or nidi in it.

It is also very important to determine the direction of motion of the clouds. In cases when the cloudiness extends over a large area in direction of motion it is necessary to distinguish its head and tail sections. The outline of the head part is dangerous and of course should not be utilized.

Observing by radar after cloudiness, the dispatcher should pay special attention to the origination of thunderstorm nidi. They must be kept in mind and in view when by-passing an intense stratus and thunderstorm cloud, which represents the greatest danger for the aircraft. A greater number of such nidi should ground all flights along the given air route until the danger abates.

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